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(54) **INTERENGAGEABLE STRUCTURAL MEMBERS**
INEINANDERGREIFENDE STRUKTURKÖRPER
ELEMENTS D'ASSEMBLAGE PROFILES

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Description

The present invention concerns a method for the manufacture of structural members adapted for telescopic edge to edge engagement with a like adjacent structural member wherein said method comprises the steps of: cold roll forming a structural member having an intermediate web member and opposed closed hollow side flanges extending along opposite sides of said web.

Such a method is known from DE-C-651 727 (nearest state of the art) wherein each pile of a sheet piling comprises a metal sheet having at each end a portion bent out of the normal plane of the sheet and formed to a hollow member, wherein the hollow member on one end being a male claw-shaped member and wherein the other hollow member is a female claw-shaped member. The external diameter of the male member is smaller than the internal diameter of the female member so that a male member of one pile can be inserted into the female member of an adjacent pile in order to connect the two piles. Both, the male member and the female member are slit in a lengthwise direction.

Co-pending International patent application number PCT/AU89/00313 (WO-A-9001091) describes a method for formation of structural members wherein a single strip of metal is continuously roll-formed to provide a central web with a hollow flange extending along each longitudinal edge. Although the central web is usually planar it may be contoured in a transverse direction. The hollow flanges may be formed in any suitable cross sectional shape such as circular, rectangular, triangular or the like and they may be of the same or different sizes.

In a further co-pending Australian patent application number PK2531 (WO-A-9205895) there is described a substantial improvement in the method and structure of the structural members disclosed in earlier co-pending International patent application number PCT/AU89/00313. This further co-pending application describes the formation of structural members comprising at least one web having at least one hollow flange extending along a longitudinal edge thereof.

The improvement described in the further co-pending application relates to the continuous fabrication in roll forming machines of structural members formed from a multiplicity of separate metal strips. This improved process enables the manufacture of structural members having a web (or webs) and a hollow flange (or flanges) wherein the web and flange components may be comprised of differing metal thicknesses and grades depending upon the requirement of the structural member. In addition, the improved process enables structural members to be formed in a wide variety of configurations.

It is an object of the present invention to provide a method for the manufacture of structural members adapted for telescopic edge to edge engagement with a like adjacent structural member with which a wide variety in configuration of structural members can be formed in an economical and fast manner.

This object is achieved by the present invention in that said hollow side flanges are initially closed by welding the free edges thereof to respective junctions between the intermediate web and the hollow flanges; and thereafter a slotted aperture is formed by removal of material from a closed wall of said hollow flange in at least one of said closed hollow side flanges, said slotted aperture extending between opposed ends of said hollow side flange parallel to said intermediate web or a slotted aperture is formed by initially forming a hollow tubular flange which is subsequently deformed inwardly to form a double walled hollow flange with a slotted aperture extending between the ends thereof.

The structural member may be formed by any suitably fabrication process but preferably is formed in a continuous roll forming process from a single strip of material and the opposed free edges of the strip are welded by high frequency electrical induction or resistance welding to the surface of the strip at the junction between the hollow flange and the intermediate web.

The slotted aperture may be formed by any suitable process of metal removal. For example the metal in the region of the slotted aperture may be removed by abrasion with a grinding wheel or a strip of metal may be removed by cutting wheels, shears or the like. Alternatively a strip of metal may be removed by a gas plasma metal cutting apparatus or a laser cutting apparatus.

The slotted aperture may also be formed by a roll forming process wherein the hollow flange is formed form a strip of metal leaving the free edges of the strip separated.

Alternatively the slotted aperture may be formed by a roll forming process wherein a hollow tubular member is initially formed followed by an inward deformation of the tubular member to form a double walled hollow flange with a slotted aperture extending longitudinally thereof.

According to a second aspect of the invention there is provided a cold roll formed steel structural member adapted for telescopic edge to edge engagement with a like adjacent structural member whenever made in accordance with a method of the present invention, said structural member comprising: an intermediate web with hollow side flanges extending along opposed sides of said web, at least one of said hollow side flanges including a slotted aperture extending between opposed ends thereof substantially parallel to said intermediate web; said structural member characterised in that said slotted aperture is spaced from the junction of the web and said at least one hollow side flanges having said slotted aperture therein to form flange wall portions extending from opposed faces of said intermediate web, said flange wall portions having spaced respective free edges defining the boundaries of said slotted aperture.

The second flange may comprise a solid element although preferably the second flange is hollow. If required said first and second flange may be hollow and

both of said first and second flanges may include a slotted aperture extending longitudinally thereof.

Suitably said first flange is adapted to receivably locate within its interior a flange of an adjacent structural member comprising at least one web element and at least one flange element extending longitudinally of an edge of said web element, said web element extending through said slotted aperture when said at least one flange element is receivably located within the interior of said first flange.

Suitably, the second flange has a cross sectional area less than the cross sectional area of the interior of the first hollow flange.

The first and second hollow flanges may have the same or different cross sectional shapes.

Preferably the cross sectional shapes of said first and second flanges are similar or identical.

Most preferably first flange may be adapted in use to receivably locate a second flange of an adjacent substantially identical structural member.

The intermediate web member may be substantially planar or alternatively it may be contoured transversely of a longitudinal axis of said structural member. If required, the web and the first and second flanges may comprise the same grade and thickness of metal or differing grades and thickness of metal.

Suitably the slotting aperture may be in the same plane as the intermediate web or in another plane inclined thereto. The slotted aperture may be of a width such as to substantially restrain relative rotational motion about a longitudinal axis between said first flange and a flange receivably located therein or alternatively the width of said slotted aperture may be such as to permit at least limited rotational motion between said first flange and a flange receivably located therein.

The composite structure may comprise a plurality of structural members each interconnecting with an adjacent structural member to form a substantially planar or non planar open composite structure.

Alternatively the composite structure may comprise a plurality of structural members each interconnecting with one or more adjacent structural members to form a single closed composite structure or a composite structure comprising open and closed portions.

The composite structure may comprise a rigid structure wherein relative movement between adjacent structural members is restrained by limiting relative rotation between a hollow flange having a slotted aperture and a flange of an adjacent structural member receivably located therein.

Alternatively the composite structure may comprise a flexible structure wherein at least limited rotational movement between adjacent structural members i6 permitted.

In order that the various aspects of the invention may be more fully understood, preferred embodiments will now be described with reference to the accompanying drawings in which

Fig 1	shows schematically the development of cross sectional shape in a roll formed structural member formed from a single strip of metal.
Figs 2-4	show typical work station roller profiles to develop the cross sectional shapes illustrated in Fig 1.
Fig 5	shows schematically the welding of the free edges of the hollow flanges of the section illustrated in Figs 1-4.
Fig 6	shows schematically cross sections during the roll forming of a hollow flanged structural member fabricated from separate strips of metal.
Fig 7	shows schematically a roll forming apparatus to produce the roll formed section of Fig 6.
Figs 8-15	show schematically typical profiling stations in the roll forming apparatus of Fig 7.
Figs 16-18	show alternative forms of attachment of hollow flanges to web sections.
Figs 19-23	illustrate a non-exhaustive array of alternative cross sectional profiles of structural members.
Fig 24	shows schematically a composite beam structure.
Fig 25	shows a cross sectional profile of a structural member according to the present invention.
Fig 26	shows a further cross sectional profile of a structural member according to the present invention.
Fig 27	shows another cross sectional profile according to the invention.
Fig 28	shows yet another cross sectional profile.
Figs 29 and 30	show enlarged cross sectional views of interengaging hollow flanges.
Fig 31	shows a non-exhaustive array of composite structures according to the invention.
Figs 32 and 33	show schematically alternative methods for forming hollow flanged structural members.
Fig 34	shows a composite structure according to yet a further aspect of the invention.
Fig 35	shows schematically a further method for forming a structural member with one or more slotted hollow flanges.

Fig 1 shows schematically a typical development of a cross sectional profile from a single strip of metal according to the process described in co-pending application number PCT/AU89/00313.

As shown in greater detail in Figs 2-4 a planar strip of metal is progressively deformed to produce a cross

sectionally arcuate intermediate web 1 with hollow flanges 2 having a generally circular cross-section extending longitudinally of web 1. Although deforming and shaping roller sets 3, 4 and 5 as shown co-operate to produce hollow flanges 2 of identical cross-sectional diameter, it will be clear to a skilled addressee that with appropriate modification, roller sets 3,4 and 5 may be adapted to produce hollow flanges 2 of differing cross sectional diameters and/or shape.

Fig 5 shows schematically the continuous welding of the free edges of hollow flanges 2 to the central web 1 to form a structural member having immense structural integrity and fluid tight hollow flanges 2.

Welding of the free edges of flanges 2 is suitably effected by a high frequency electrical induction or resistance welding apparatus shown generally at 7. After welding, the central web 2 may be reshaped by further deforming or shaping rollers (not shown) to produce a web 2 having a planar or profiled cross sectional shape.

Fig 6 shows schematically the development of a structural member from separate strips of metal.

At stage 1, metal strips representing web strip 10 and flange strips 11, 12 are fed into a tandem station roll forming apparatus or alternatively flange strips 11, 12 are passed through separate roll forming mills while web strip 10 passes therebetween.

Strips 11, 12 are progressively deformed to produce hollow side flanges 13, 14 having elongate slotted apertures 13a, 14a respectively as shown at stage 4. The hollow flanges 13, 14 are guided towards web strip 10 until the free edges of web strip 10 are located within slotted apertures 13a, 14a. The free edges of flanges 13, 14 are then urged into contact with web strip 10 as shown at stage 5 by opposing rollers in the region of a welding station wherein the free edges of flanges 13, 14 are welded to web strip 10 to form an integral structure.

Flanges 13, 14 may then be shaped to any desired shape as illustrated at stages 6-8 by shaping rollers located downstream of the welding station.

Fig 7 shows schematically an apparatus used to produce the structural member of Fig 1.

In Fig 7 the apparatus comprises separate let-off stations 30, 31, 32 each supporting separate coiled rolls 33, 34, 35 of sheet steel, each of the same or different thickness and width if required. Strips 36 and 38 issuing from rolls 33, 35 respectively are directed to roll forming mills 39,40 to form hollow members 41, 42 respectively of predetermined shape and cross sectional area. As illustrated at stage 4 in Fig 6, the respective pairs of free edges are slightly separated to form continuous slots which face a respective edge of central strip or web 37.

In the region of welding station 43 the free edges of web 37 are guided by rollers 44 into the respective slots in adjacent hollow members 41, 42 to a respective distance equal to the respective wall thicknesses of members 41, 42. Nip rollers 45 compress members 41,42 to urge their respective free edges into contact with upper and lower surfaces of web 37 immediately prior to welding by high frequency electrical induction or resistance welding units 46. Rollers 47, 48, 49 and 50 initially support web 37 and subsequently the integral structure 51.

The structure 51 is then severed into predetermined lengths by a flying saw (not shown) or the like.

Suitably roll forming mills 39, 40 are laterally movable to accommodate differing widths of web 37.

Figs 8-15 show schematically typical rolling stations which may be employed in rolling mills 39, 40 in Fig 7 to produce the hollow flange members 13, 14 shown at stage 4 in Fig 6.

A number of significant variations may be made to the method and apparatus of the invention to achieve a wide variety of structural members.

Fig 16 shows, for example, that the system of Fig 7 may be adapted such that in the process of welding the lips 60 of a slotted tubular member to the opposing surfaces of a web member 63, a free edge 61 of the web member may be guided fully into either or both of the tubular members 62 until it engages the inner wall of the tubular member. If required the free edge of the web 63 may be additionally welded to the interior of the tubular member 62 by high frequency induction welding to form a hollow flange divided into separate fluid tight compartments.

Fig 17 shows an alternative configuration wherein lips 60 are welded to opposing faces of web 63 adjacent its edges.

Fig 18 shows yet another configuration wherein a free edge 64 of web 63 is welded to the outer surface of a hollow flange 65 having a slotted aperture 66 extending longitudinally thereof diametrically opposite the attachment point of web 63. Slotted aperture 66 is formed by leaving the free edges 65a of flange 65 separated and maintaining the separation at a predetermined spacing during the shaping process by projections 67 on outer rolls 68.

In other variations the central web may include pre or post formed apertures or it may include a longitudinally or transversely extending profiled shape in the form of deep or shallow channels, ribs or the like. In the case of transversely extending contoured profiles, the inwardly facing regions of opposed hollow flanges include planar faces arranged perpendicularly to the edges of the web to facilitate welding of the components of the structural member.

Figs 19-23 and 24 show a non-exhaustive array of flange shapes and composite structures.

Fig 24 in particular shows a composite structure formed in accordance with the invention disclosed in co-pending Australian application PCT/AU89/00313. In this structure the lower portion comprising flanges 70, 71 and web 72 is formed from a single strip of metal in accordance with co-pending application PCT/AU89/00313 to which is subsequently added web 73 and hollow flange 74 (formed from separate strips of metal).

Fig 25 shows a cross-sectional configuration of a structural member 80 formed in accordance with the

present invention. The structural member 80 comprises a web 81 having an arcuate stiffening rib 82 formed therein. A hollow flange 83 has its free edge 84 welded to web 81 to form a fluid impervious conduit.

A second hollow flange 85 is formed on the opposite side of web 81 and the free edge 86 of flange 85 is also welded to web 81. A slotted aperture 87 is formed in the wall of flange 85 in the same plane as web 21.

The outer diameter of flange 83 is slightly smaller than the inner diameter of flange 85 whereby adjacent structural members 80 may be interconnected to form a composite structure by lengthwise slidingly engaging small flange 83 of one structural member within a large flange 85 of another structural member.

The structural member 80 may be formed from one or more strips of metal as generally described above and the slotted aperture is formed after the free edge 86 of flange 85 is welded to web 81. The slotted aperture is formed continuously by a gas plasma or laser cutting apparatus and the strip of metal removed is discarded as scrap.

Fig 26 shows an alternative configuration of a structural member 90 wherein web 91 is formed as a channel-like section. Flange 92 is of a smaller diameter than flange 93 whereby after slotting flange 93, flange 92 may be slidingly located therein.

Fig 27 shows a similar configuration to Fig 26 except that a much thicker strip of metal is employed to fabricate the structural member 90.

Fig 28 shows yet another embodiment of a structural member 97 comprising a channel shaped web 95 and a pair of hollow flanges 96 of equal diameter having large slotted apertures 98, 99, the purpose of which will be described with reference to Figs 29 and 30.

Fig 29 is an enlarged cross sectional view of a small flange 92 of the structural member 90 shown in Fig 27 engaged in a slotted aperture 100 of flange 93 of an adjacent structural member 90. Slotted aperture 100 is of a width greater than the thickness of web 91 to allow it limited pivotal movement between flanges 92 and 93.

Fig 30 shows an enlarged cross sectional view of the interengaging flanges 92 and 93 of Fig 29 engaged within a slotted flange 96 of structural member 97 shown in Fig 28. Relative pivotal movement between flanges 92, 93 and 96 is permitted to at least a limited degree.

Fig 31 illustrates composite structures permissable with the structural members illustrated generally in Figs 27, 28 and 29.

Figs 31a, 31b and 31c show cross sections of hollow columnar structures which may be utilized as structural columns, free standing poles or box beams. These structures may be hollow or filled with reinforced concrete (with or without pre-stressing steel reinforcing bars) or other reinforcing material such as carbon, synthetic or glass fibres in a resin matrix. If required, the columnar structures may also include post-stressed tendons.

Fig 31d shows a composite structure comprising interconnected structural members shown generally in Figs 26 and 27. This composite structure may be utilized in an upright manner as a structural barrier such as a wall for a building, marine piling, shuttering for earthworks or the like.

In a horizontal configuration, the interconnected structural members may form a reinforced support for concrete slab floors, mine wall and roof reinforcing barriers or even as horizontal walling on a structural frame.

Fig 31e shows yet another structural configuration comprising a combination of structural members illustrated in Figs 26, 27 and 28 wherein the structural members of Fig 28 form spaced columns or box beams 101 to provide additional upright or transverse reinforcing to a barrier-like structure.

A structural member 102 interconnected to a junction 103 of adjacent interconnecting structural members 104 and arranged perpendicularly thereto may form an alternative form of structural support or reinforcing to a composite structure according to the invention.

Fig 32 shows an alternative method of fabricating structural elements according to the invention.

The structural member 110 is fabricated by continuously forge welding flange strips 111, 112 to a web 113. Forge welding is a well known process for fabricating I- and T- beams and is generally described in US Patent No 3,713,205.

Downstream of the forge welding station is a roll forming mill which deforms flange strips 111, 112 away from web 113 to form hollow flanges 114, 115. Hollow flange 114 is formed as a closed integral member by fusing together the free edges of flange strip 111 by high frequency electrical induction or resistance welding. Hollow flange 115 may be formed in a similar manner by fusing together the free ends of flange strip 112 and then subsequently forming slotted aperture 116 by removing a strip of metal by, say, a gas plasma or laser metal cutting apparatus.

Alternatively, slotted aperture 116 may be formed by roll forming flange strip 112 such that its free edges are spaced to form aperture 116.

Fig 33 shows a variation of the process described in Fig 32.

In this variation flange strip 111 is deformed towards web 113 and the free ends of flange strip 111 are fused to the sides of web 113 to form a hollow flange 114 which is internally reinforced by the edge portion of web 113.

The free ends of flange strip 111 are fused to web 113 by high frequency electrical induction or resistance welding.

Fig 34 shows a composite structure comprising a plurality of structural members 120 each comprising a web 121 with a closed hollow flange 122 extending along one side of web 121 and a larger hollow flange 123 extending along the opposite side of web 121.

Hollow flange 123 includes a slotted aperture 124 extending longitudinally thereof and parallel to the plane of web 121. The internal diameter of flange 123 is cho-

sen to accommodate an opposite smaller hollow flange of an adjacent structural member.

The composite structure so formed provides a sheet-like structure reinforced by hollow flanges 122 and 123. The width of slotted aperture 124 may be chosen to permit a relatively rigid composite structure or at least limited co-axial relative rotation between engaging flanges 123, 124 to permit an arcuate or contoured structure rather than the planar structure illustrated.

Such a composite structure may be employed as a structural support/lining for tunnels, bridge construction etc. In thin gauge metal, such a structure may be employed as roofing or wall cladding. In heavier gauges, the structure may be employed as piling or shuttering in earthworks.

In Fig 35 a structural member 130 having a hollow flange 131 may be formed from a single metal strip by a process described in co-pending application no PCT/AU89/00313 or from a plurality of metal strips by a process described in co-pending patent application number PK2531.

The hollow flange 131 is then deformed in a continuous roll forming operation to flatten the flange to form a double walled planar flange 132 extending longitudinally of an edge of web 133.

Planar flange 132 is subsequently deformed by roll forming to produce a generally hollow double walled flange 134 with a longitudinal slot 135 extending therealong. While hollow slotted flange 133 is shown as generally circular in cross section it should be appreciated that the cross-sectional shape may be roll formed to any suitable cross section.

This variation of the process according to the invention may be employed to provide a reinforced hollow flange where the use of a thicker flange strip may not be possible or otherwise where the use of a thin flange strip is advisable for economic or process efficiency reasons.

Claims

1. A method for the manufacture of structural members adapted for telescopic edge to edge engagement with a like adjacent structural member, said method comprising the steps of:

   cold roll forming a structural member (97; 110; 130) having an intermediate web member (95; 113; 133) and opposed closed hollow side flanges (96; 114, 115; 131) extending along opposite sides of said web (95; 113; 133), said method characterised in that said hollow side flanges (96; 114, 115; 131) are initially closed by welding the free edges thereof to respective junctions between the intermediate web (95; 113; 133) and the hollow flanges (96; 114, 115; 131); and thereafter a slotted aperture (98; 116) is formed by removal of material from a closed wall of said hollow flange in at least one of said closed hollow side flanges(96; 115), said slotted aperture (98; 116) extending between opposed ends of said hollow side flange (96; 115) parallel to said intermediate web (95; 113) or

   a slotted aperture (135) is formed by initially forming a hollow tubular flange (131) which is subsequently deformed inwardly to form a double walled hollow flange (134) with a slotted aperture (135) extending between the ends thereof.

2. A method as claimed in claim 1 wherein said structural member is formed in a continuous roll forming process from a single strip of material and the opposed free edges of the strip are welded by high frequency electrical induction or resistance welding to the surface of the strip at the junction between the hollow flange (96) and the intermediate web (95).

3. A method as claimed in claim 1 wherein the structural member is formed in a continuous roll forming process from separate strips of material comprising said intermediate web (113) and at least one of said hollow flanges (114), the free edges of the strip comprising said at least one hollow flange (114) being fused on opposite surfaces of said web (113) adjacent an edge thereof by high frequency electrical induction or resistance welding.

4. A cold roll formed steel structural member (97) adapted for telescopic edge to edge engagement with a like adjacent structural member whenever made in accordance with a method of any one of claims 1 to 3, said structural member comprising:

   an intermediate web (95) with hollow side flanges (96) extending along opposed sides of said web (95), at least one of said hollow side flanges (96) including a slotted aperture (98) extending between opposed ends thereof substantially parallel to said intermediate web (95);

   said structural member characterised in that said slotted aperture (98) is spaced from the junction of the web (95) and said at least one hollow side flanges (96) having said slotted aperture therein to form flange wall portions extending from opposed faces of said intermediate web (95), said flange wall portions having spaced respective free edges defining the boundaries of said slotted aperture (98).

5. A structural member as claimed in claim 4 wherein said slotted aperture (98) is positioned in a hollow side flange wall at an angle of between 30° to 180° relative to a plane extending between the longitudinal axis of said hollow side flange (96) and the junction of said hollow side flange (96) and a respective

side of said intermediate web (95).

6. A structural member as claimed in claim 4 or claim 5 wherein both of said opposing hollow side flanges (96) include a slotted aperture (98) extending between respective ends thereof.

7. A structural member as claimed in any one of claims 4 to 6 wherein opposing hollow side flanges (96) have substantially circular cross sections.

8. A structural member as claimed in any one of claims 4 to 7 wherein said slotted aperture (98) has a width such as to permit limited rotational movement of a telescopically engaged hollow flange (96) of a like adjacent structural member without flexure of said aperture hollow side flange (96).

9. A structural member as claimed in any one of claims 4 to 7 wherein said slotted aperture (98) has a width such as to substantially restrain relative rotational movement between said apertured hollow flange (98) and a telescopically engaged hollow flange (98) of a like adjacent structural member.

10. A structural member as claimed in any one of claims 4 to 9 wherein the intermediate web (97) and said hollow side flanges (96) extending along opposed sides of said web (97) are formed from the same strip of material.

11. A structural member as claimed in any one of claims 4 to 9 wherein the intermediate web (97) and at least one of said hollow side flanges (96) are formed respectively from separate strips of material welded together.

12. A structural member as claimed in any one of claims 4 to 11 wherein said apertured hollow side flange comprises a double walled structure (134).

13. A composite structure comprising a plurality of edge to edge telescopically engaged structural members (120) according to any one of claims 4 to 12.

14. A composite structure as claimed in claim 13 wherein respective opposite hollow side flanges of a plurality of structural members are telescopically engaged with respective hollow side flanges of adjacent structural members to form a hollow structure (101).

15. A composite structure (101) as claimed in claim 13 or claim 14 further including structural members (102) having opposed apertured side flanges adapted to telescopically engage over already telescopically edge to edge engaged adjacent structural members (104).

Patentansprüche

1. Verfahren zur Herstellung von Bauelementen, die für einen teleskopischen Rand-an-Rand-Eingriff mit einem gleichen benachbarten Bauelement angepaßt sind, wobei das Verfahren die Schritte umfaßt:

   Formen eines Bauelementes (97; 110; 130) durch Kaltwalzen, das ein Zwischenwandelement (95; 113; 133) und gegenüberliegende geschlossene hohle Seitenflansche (96; 114, 115; 131) aufweist, die sich entlang gegenüberliegender Seiten der Wand (95; 113; 133) erstrecken, wobei das Verfahren dadurch gekennzeichnet ist, daß die hohlen Seitenflansche (96; 114, 115; 131) anfänglich durch Verschweißen ihrer freien Ränder an jeweiligen Verbindungen zwischen den Zwischenwänden (95, 113; 133) und den hohlen Flanschen (96; 114, 115; 131) verschlossen werden; und hiernach eine Schlitzöffnung (98; 116) durch Entfernen des Materials aus einer verschlossenen Wand des hohlen Flansches in zumindest einem der geschlossenen hohlen Seitenflansche (96; 115) geformt wird, wobei sich die Schlitzöffnung (98; 116) zwischen gegenüberliegenden Enden des parallel zur Zwischenwand (95; 113) erstreckenden hohlen Seitenflansches (96; 115) erstreckt oder
   eine Schlitzöffnung (135) durch anfängliches Formen eines hohlen rohrförmigen Flansches (131) gebildet wird, welcher nachfolgend einwärts verformt wird, um einen doppelwandigen hohlen Flansch (134) mit einer sich zwischen dessen Enden erstreckenden Schlitzöffnung (135) zu formen.

2. Verfahren nach Anspruch 1, bei welchem das Bauelement in einem kontinuierlichen Kaltwalzverfahren aus einem einzelnen Materialstreifen geformt wird und die gegenüberliegenden freien Ränder des Streifens durch hochfrequentes Elektroinduktions- oder Widerstandsschweißen mit der Oberfläche des Streifens an der Verbindung zwischen dem hohlen Flansch (96) und der Zwischenwand (95) verschweißt werden.

3. Verfahren nach Anspruch 1, bei dem das Bauelement in einem kontinuierlichen Kaltwalzverfahren aus separaten Materialstreifen geformt wird, welche die Zwischenwand (113) und zumindest einen der hohlen Flansche (114) umfassen, wobei die freien Ränder des zumindest einen hohlen Flansch (114) umfassenden Streifens auf gegenüberliegenden Flächen der benachbart zu einem Rand hiervon liegenden Wand (113) durch hochfrequentes Elektroinduktions- oder Widerstandsschweißen verschmolzen werden.

4. Kaltgewalztes Stahlbauelement (97), das für einen teleskopischen Rand-an-Rand-Eingriff mit einem gleichen benachbarten Bauelement angepaßt ist und gemäß einem Verfahren nach einem der vorhergehenden Ansprüche 1 bis 3 hergestellt ist, wobei das Bauelement umfaßt:

   eine Zwischenwand (95) mit hohlen Seitenflanschen (96), welche sich entlang gegenüberliegenden Seiten der Wand (95) erstrecken, wobei zumindest einer der hohlen Seitenflansche (96) eine Schlitzöffnung (98) beinhaltet, welche sich zwischen gegenüberliegenden Enden hiervon im wesentlichen parallel zur Zwischenwand (95) erstreckt;

   wobei das Bauelement dadurch gekennzeichnet ist, daß die Schlitzöffnung (98) von der Verbindung der Wand (95) und dem zumindest einen hohlen Seitenflansch (96), der die Schlitzöffnung aufweist, um sich von entgegengesetzten Seiten der Zwischenwand (95) erstreckende Flanschwandabschnitte zu formen, beabstandet ist, wobei die Flanschwandabschnitte jeweils voneinander beabstandete freie Ränder aufweist, welche die Begrenzungen der Schlitzöffnung (98) definieren.

5. Bauelement nach Anspruch 4, bei dem die Schlitzöffnung (98) in einer hohlen Seitenflanschwand in einem Winkel zwischen 30° bis 180° relativ zu einer sich zwischen der Längsachse des hohlen Seitenflansches (96) und der Verbindung des hohlen Seitenflansches (96) und einer entsprechenden Seite der Zwischenwand (95) erstreckenden Ebene positioniert ist.

6. Bauelement nach Anspruch 4 oder 5, bei dem beide gegenüberliegende hohle Seitenflansche (96) eine sich zwischen deren jeweiligen Enden erstreckende Schlitzöffnung (98) beinhalten.

7. Bauelement nach einem der vorhergehenden Ansprüche 4 bis 6, bei dem gegenüberliegende hohle Seitenflansche (96) im wesentlichen kreisförmige Querschnitte haben.

8. Bauelement nach einem der vorhergehenden Ansprüche 4 bis 7, bei dem die Schlitzöffnung (98) eine derartige Breite hat, um so eine begrenzte Drehbewegung eines teleskopisch eingefügten hohlen Flansches (96) eines gleichen benachbarten Bauelementes ohne Verbiegung der Öffnung im hohlen Seitenflansch (96) zu erlauben.

9. Bauelement nach einem der Ansprüche 4 bis 7, bei dem die Schlitzöffnung (98) eine derartige Breite hat, um eine relative Drehbewegung zwischen dem geöffneten hohlen Flansch (98) und einem teleskopisch eingerasteten hohlen Flansch (98) eines gleichen benachbarten Bauelementes im wesentlichen zu verhindern.

10. Bauelement nach einem der Ansprüche 4 bis 9, bei dem die Zwischenwand (97) und die hohlen Seitenflansche (96), welche sich entlang gegenüberliegender Seiten der Zwischenwand (97) erstrecken, aus dem gleichen Materialstreifen geformt sind.

11. Bauelement nach einem der Ansprüche 4 bis 9, bei dem die Zwischenwand (97) und zumindest einer der hohlen Seitenflansche (96) jeweils aus separaten zusammengeschweißten Materialstreifen geformt sind.

12. Bauelement nach einem der Ansprüche 4 bis 11, bei dem der geöffnete hohle Seitenflansch eine doppelwandige Struktur (134) umfaßt.

13. Zusammengesetzte Konstruktion, umfassend mehrere Randan-Rand teleskopisch eingerasteter Bauelemente (120) gemäß einem der Ansprüche 4 bis 12.

14. Verbundkonstruktion nach Anspruch 13, bei der jeweilige gegenüberliegende hohle Seitenflansche mehrerer Bauelemente mit jeweiligen hohlen Seitenflanschen benachbarter Bauelemente teleskopisch eingerastet sind, um eine hohle Konstruktion (101) zu bilden.

15. Verbundkonstruktion (101) nach Anspruch 13 oder Anspruch 14, ferner beinhaltend Bauelemente (102), welche gegenüberliegende geöffnete Seitenflansche aufweisen, die über bereits teleskopisch Rand-an-Rand eingreifende benachbarte Bauelemente (104) teleskopisch einrastbar sind.

Revendications

1. Procédé pour la fabrication d'éléments structurels conçus pour la fixation télescopique bord à bord avec un élément structurel adjacent identique, ledit procédé comprenant les étapes consistant à :

   former un élément structurel (97 ; 110 ; 130) par laminage à froid, comportant un élément d'âme intermédiaire (95 ; 113 ; 133) et des ailes latérales creuses fermées opposées (96 ; 114, 115 ; 131) s'étendant le long des côtés opposés de ladite âme (95 ; 113 ; 133), ledit procédé étant caractérisé en ce que lesdites ailes latérales creuses (96 ; 114, 115 ; 131) sont fermées initialement en soudant les bords libres de celles-ci à des points de jonction respectifs entre l'âme intermédiaire (95 ; 113 ; 133) et les ailes creuses (96 ; 114, 115 ; 131), et une ouverture en fente (98 ; 116) est ensuite formée par enlèvement de matière d'une paroi

fermée de ladite aile creuse dans au moins l'une desdites ailes latérales creuses (96 ; 115), ladite ouverture en fente (98 ; 116) s'étendant entre les extrémités opposées de ladite aile latérale creuse (96 ; 115) parallèlement à ladite âme intermédiaire (95 ; 113) ou bien

une ouverture en fente (135) est formée en formant initialement une aile tubulaire creuse (131) qui est ensuite déformée vers l'intérieur afin de former une aile creuse à double paroi (134) comportant une ouverture en fente (135) s'étendant entre les extrémités de celle-ci.

2. Procédé selon la revendication 1, dans lequel ledit élément structurel est formé au cours d'un processus de formage au laminoir en continu à partir d'une seule bande de matériau, et les bords libres opposés de la bande sont soudés, par soudage par induction à haute fréquence ou par résistance, à la surface de la bande, au niveau du point de jonction entre l'aile creuse (96) et l'âme intermédiaire (95).

3. Procédé selon la revendication 1, dans lequel l'élément structurel est formé au cours d'un processus de formage au laminoir continu à partir de bandes séparées de matériau comprenant ladite âme intermédiaire (113) et au moins une desdites ailes creuses (114), les bords libres de la bande comprenant ladite au moins une aile creuse (114) qui est soudée sur des surfaces opposées de ladite âme (113) à proximité immédiate d'un bord de celle-ci, par soudage par induction à haute fréquence ou par résistance.

4. Elément structure (97) en acier formé par laminage à froid, conçu pour la fixation télescopique bord à bord avec un élément structurel adjacent identique, réalisé conformément à un procédé selon l'une quelconque des revendications 1 à 3, ledit élément structurel comprenant :

une âme intermédiaire (95) avec des ailes latérales creuses (96) s'étendant le long de côtés opposés de ladite âme (95), au moins l'une desdites ailes latérales creuses (96) comprenant une ouverture en fente (98) s'étendant entre les extrémités opposées de celle-ci, sensiblement parallèlement à ladite âme intermédiaire (95),

ledit élément structurel étant caractérisé en ce que ladite ouverture en fente (98) est espacée de la jonction entre l'âme (95) et ladite au moins une aile latérale creuse (96) comportant ladite ouverture en fente dans celle-ci afin de former des parties de paroi d'ailes s'étendant à partir de faces opposées de ladite âme intermédiaire (95), lesdites parties de paroi d'aile comportant des bords libres respectifs espacés définissant les limites de ladite ouverture en fente (98).

5. Elément structurel selon la revendication 4, dans lequel ladite ouverture en fente (98) est positionnée dans une paroi d'aile latérale creuse suivant un angle compris entre 30° et 180° par rapport à un plan s'étendant entre l'axe longitudinal de ladite aile latérale creuse (96) et la jonction de ladite aile latérale creuse (96) avec un côté respectif de ladite âme intermédiaire (95).

6. Elément structurel selon la revendication 4 ou la revendication 5, dans lequel les deux dites ailes latérales creuses opposées (96) comprennent une ouverture en fente (98) s'étendant entre les extrémités respectives de celles-ci.

7. Elément structurel selon l'une quelconque des revendications 4 à 6, dans lequel les ailes latérales creuses opposées (96) présentent une section transversale sensiblement circulaire.

8. Elément structurel selon l'une quelconque des revendications 4 à 7, dans lequel ladite ouverture en fente (98) présente une largeur telle qu'elle permet un mouvement de rotation limité d'une aile creuse engagée de façon télescopique (96) d'un élément structurel identique adjacent sans déformation de ladite aile latérale creuse à ouverture (96).

9. Elément structurel selon l'une quelconque des revendications 4 à 7, dans lequel ladite ouverture en fente (98) présente une largeur telle qu'elle limite sensiblement le mouvement de rotation relatif entre ladite aile creuse à ouverture (96) et une aile creuse (96) engagée de façon télescopique d'un élément structurel identique adjacent.

10. Elément structurel selon l'une quelconque des revendications 4 à 9, dans lequel l'âme intermédiaire (97) et lesdites ailes latérales creuses (96) s'etendant le long des côtés opposés de ladite âme (97) sont formées à partir de la même bande de matériau.

11. Elément structurel selon l'une quelconque des revendications 4 à 9, dans lequel l'âme intermédiaire (97) et au moins l'une desdites ailes latérales creuses (96) sont formées respectivement à partir de bandes séparées de matériau soudées ensemble.

12. Elément structurel selon l'une quelconque des revendications 4 à 11, dans lequel ladite aile latérale creuse à ouverture comprend une structure à double paroi (134).

13. Structure composite comprenant une pluralité d'éléments structurels (120) fixés de façon télescopique bord à bord, selon l'une quelconque des revendications 4 à 12.

14. Structure composite selon la revendication 13, dans laquelle les ailes latérales creuses opposées respectives d'une pluralité d'éléments structurels sont engagés de façon télescopique dans les ailes latérales creuses respectives d'éléments structurels adjacents afin de former une structure creuse (101).

15. Structure composite (101) selon la revendication 13 ou la revendication 14, comprenant en outre des éléments structurels (102) comportant des ailes latérales opposées à ouverture conçues pour s'emboîter de façon télescopique sur des éléments structurels adjacents déjà fixés bord à bord de façon télescopique (104).

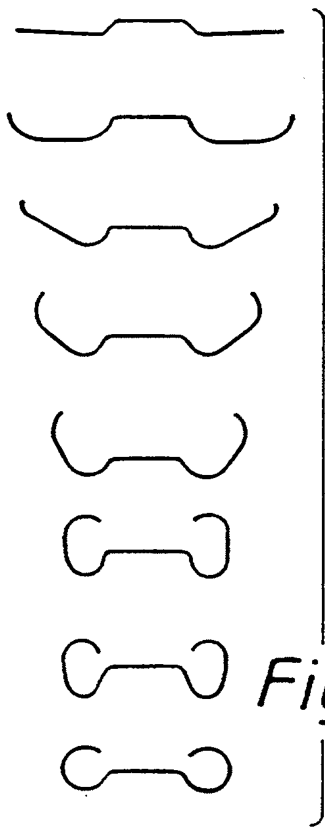
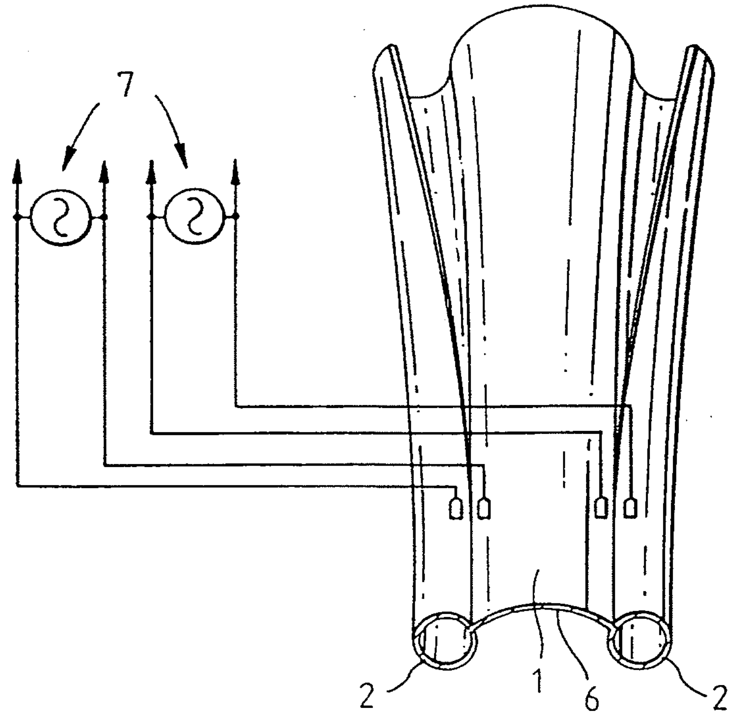


Fig. 1.

Fig. 5.



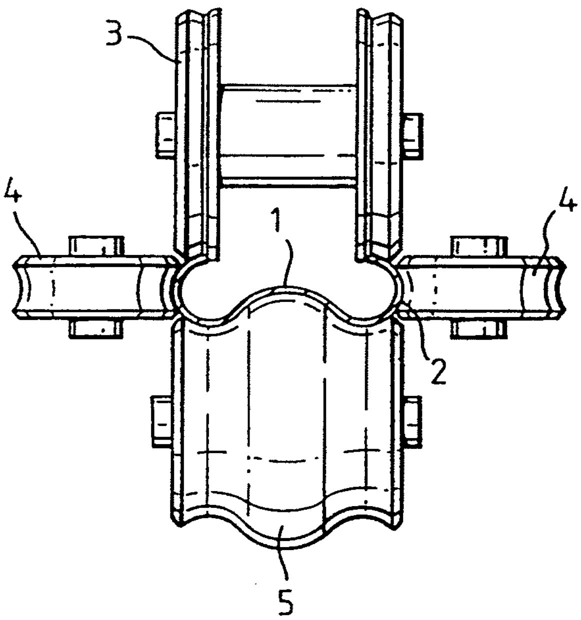


Fig.2.

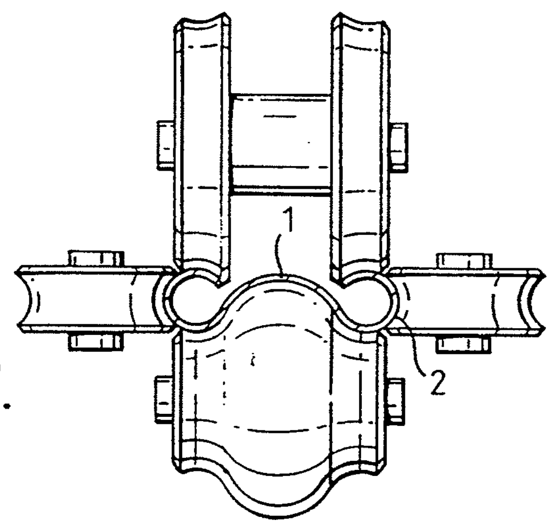


Fig.3.

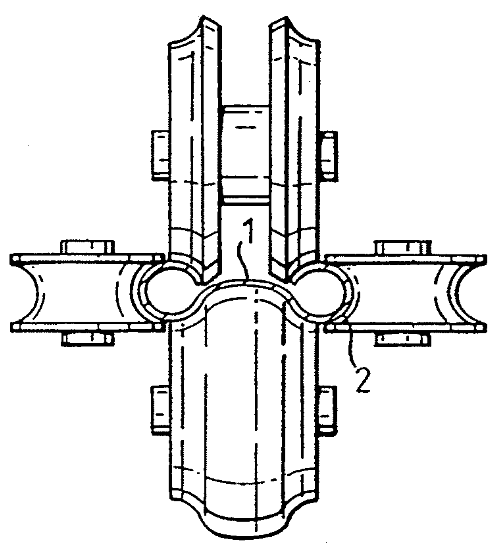
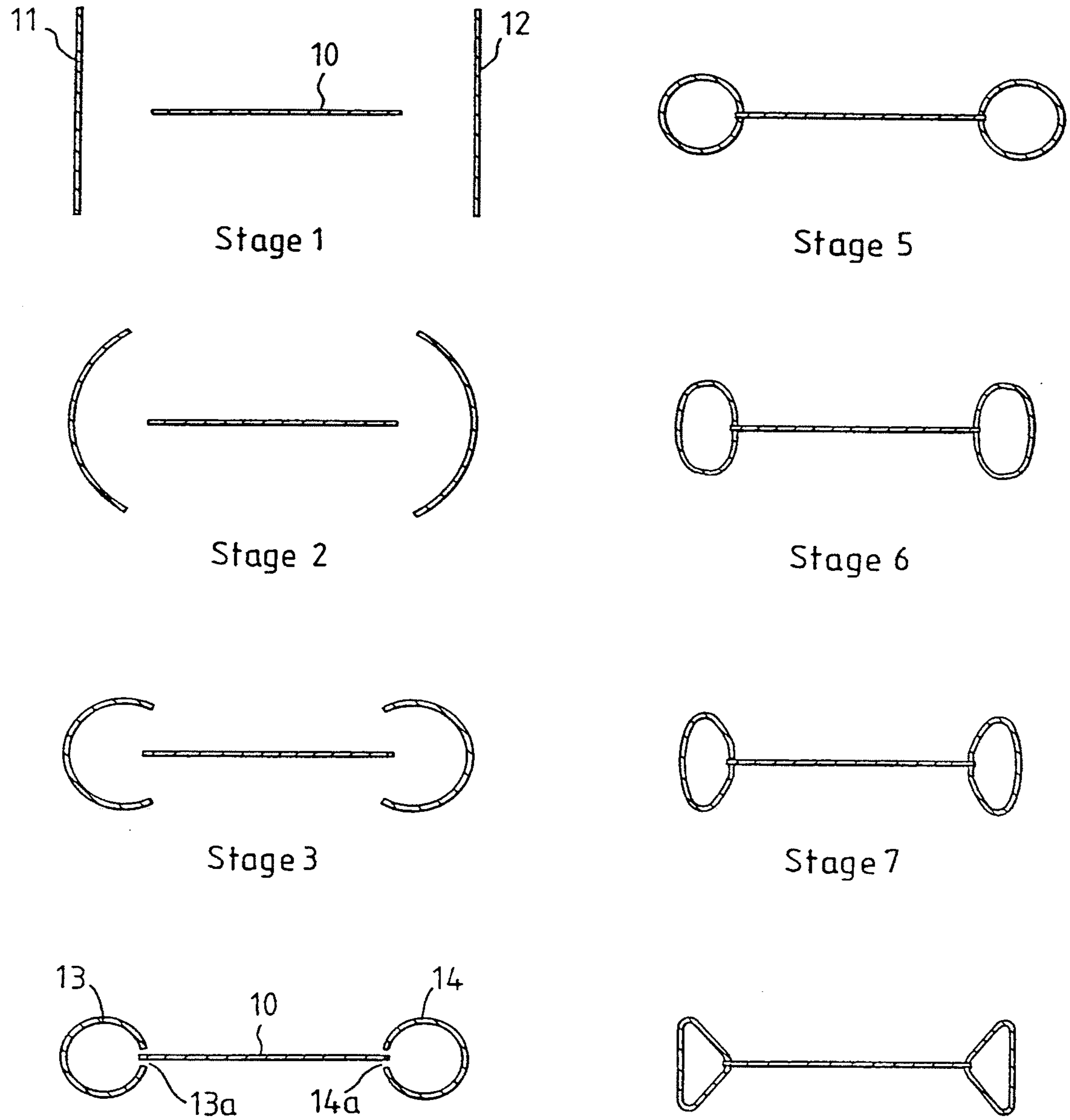


Fig.4.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12
Stage 1
Stage 5
Stage 2
Stage 6
Stage 3
Stage 7
13
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14
13a
14a
Stage 4
Stage 8

Fig.6.

Fig.7.

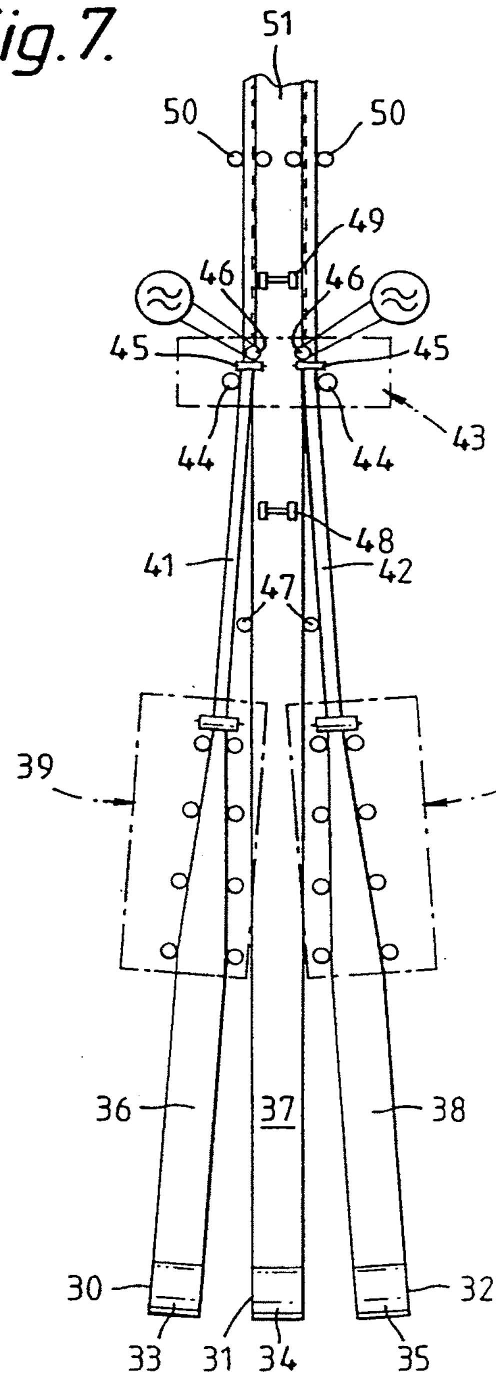
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Fig. 8.

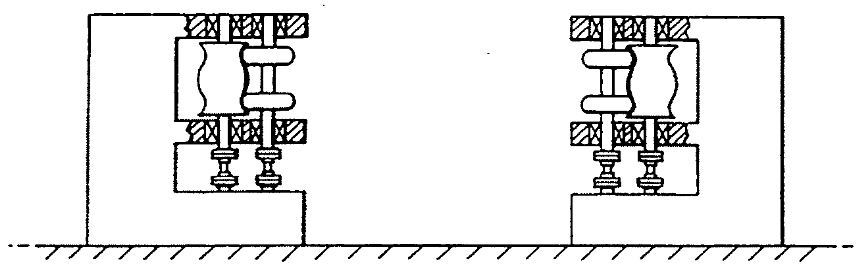


Fig. 9.

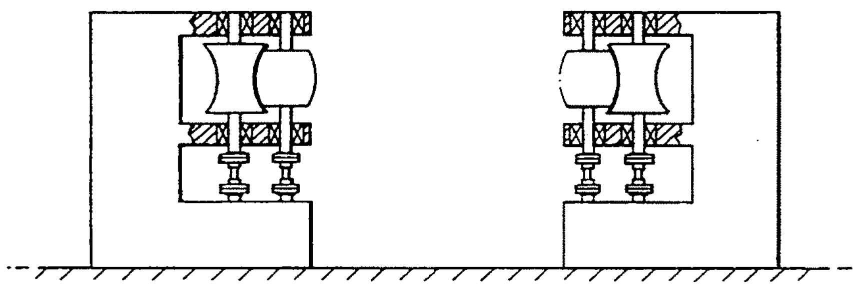


Fig. 10.

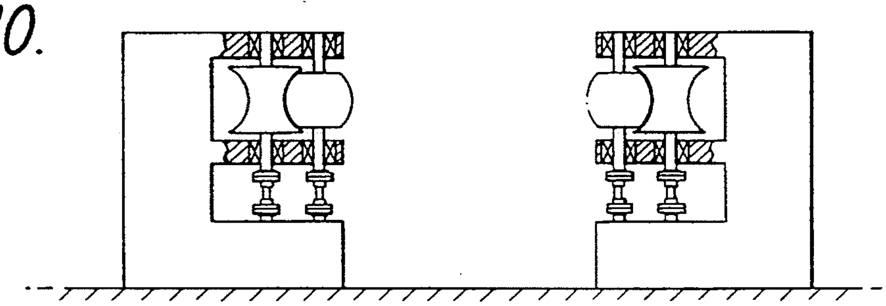


Fig. 11.

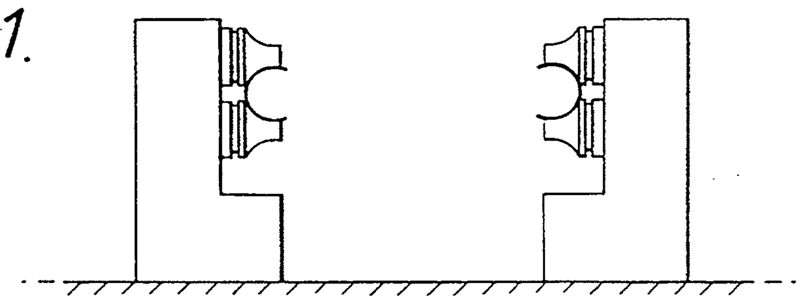


Fig.12.

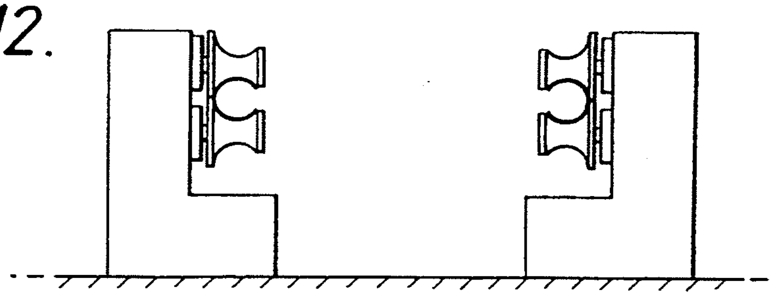


Fig.13.

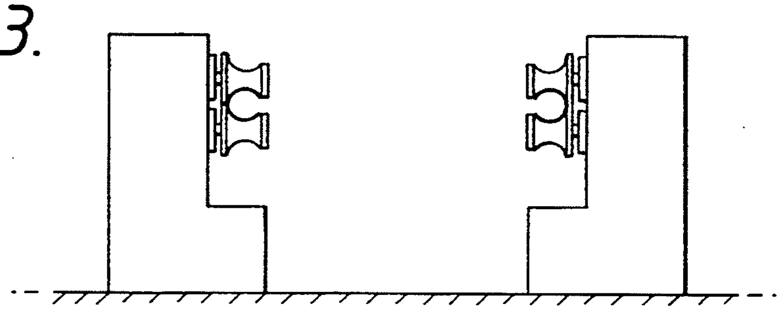


Fig.14.

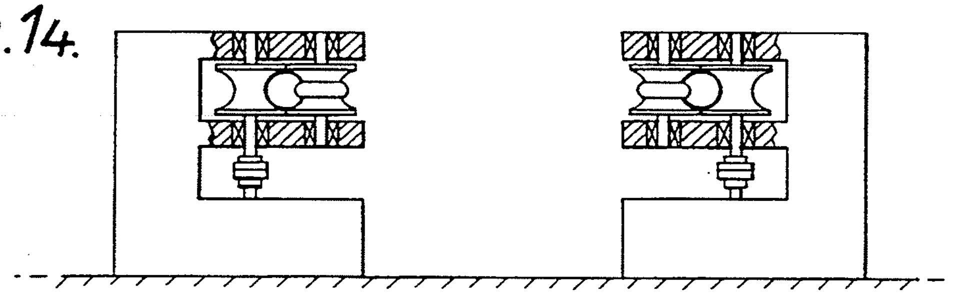
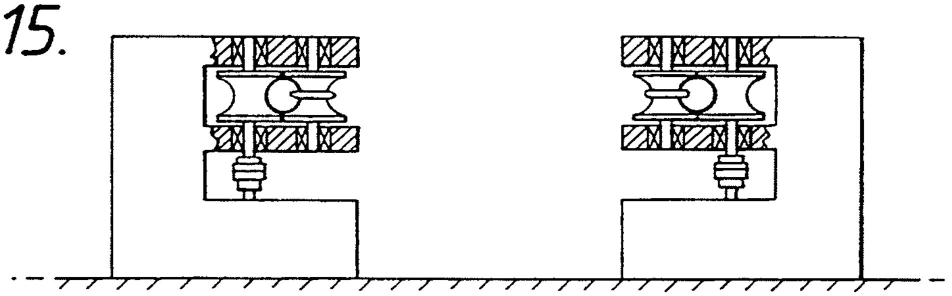
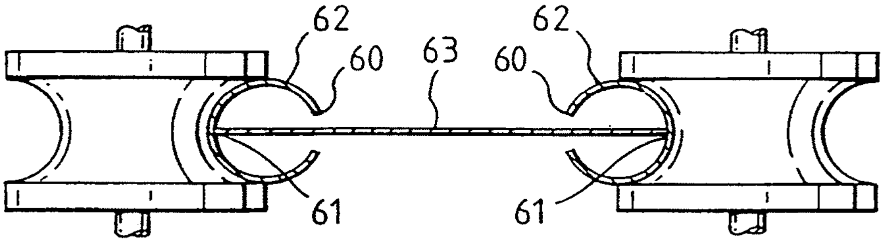


Fig.15.





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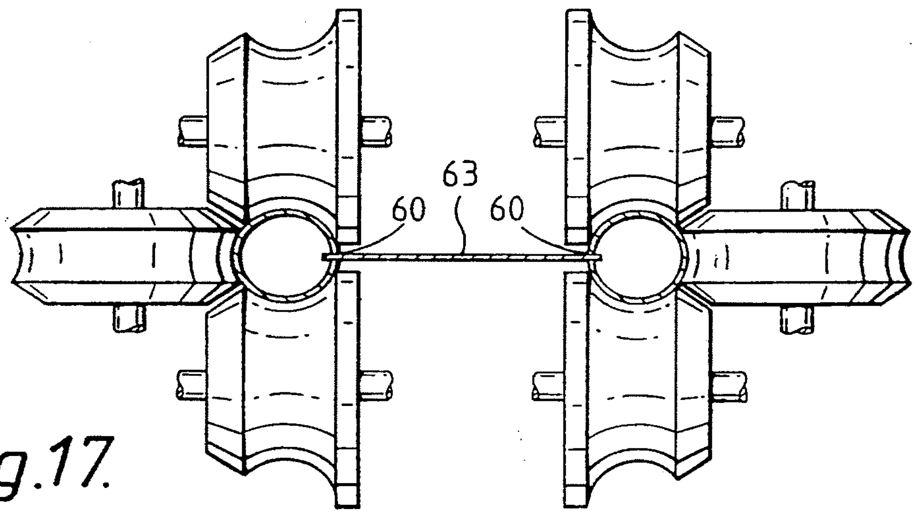

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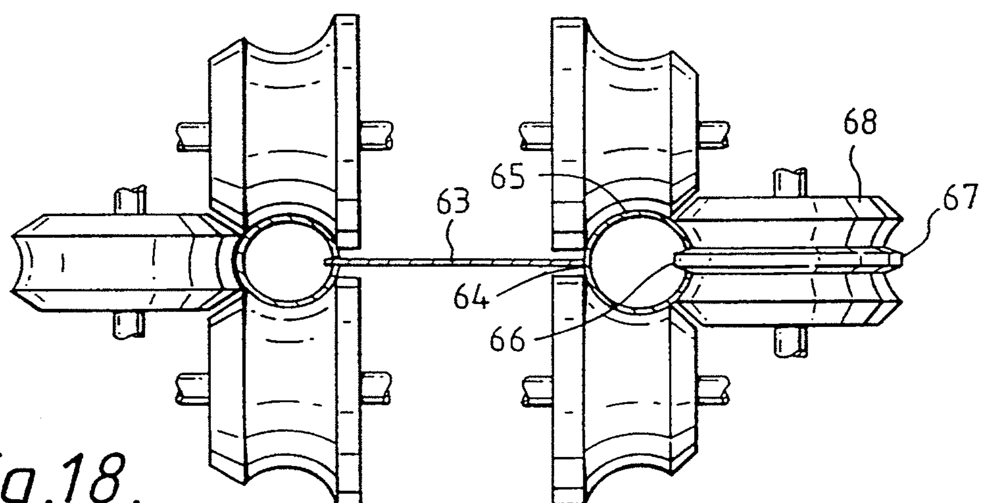


Fig.18.

(a) (b)

Fig.19.

(a) (b)

Fig.20.

(a) (b)

Fig.21.

(a) (b)

Fig.22.

(a) (b)

Fig.23.

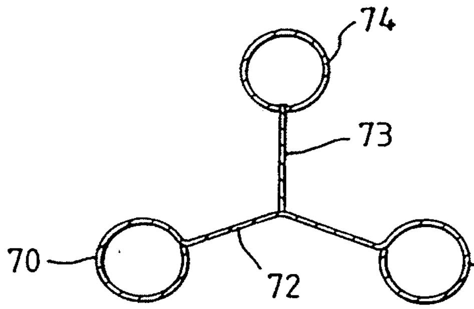


Fig.24.

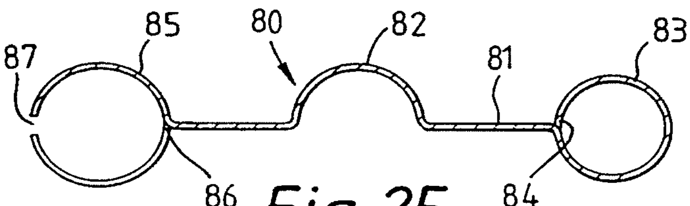


Fig.25.

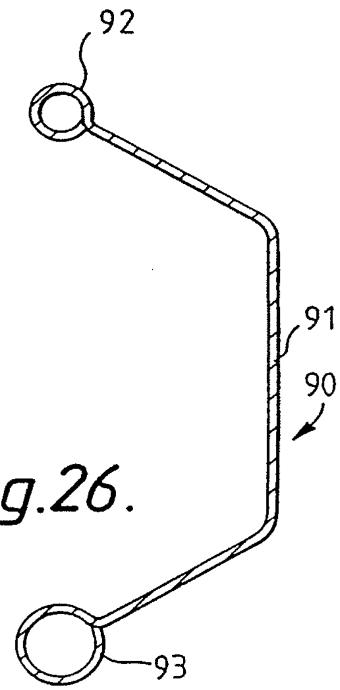


Fig.26.

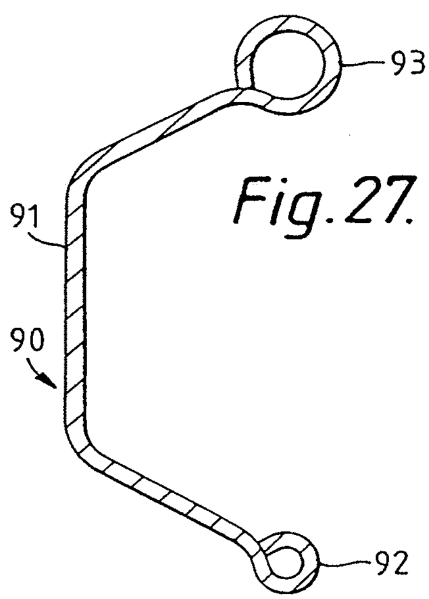


Fig.27.

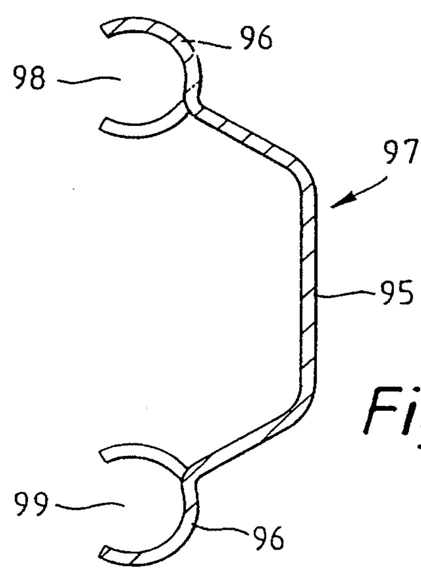
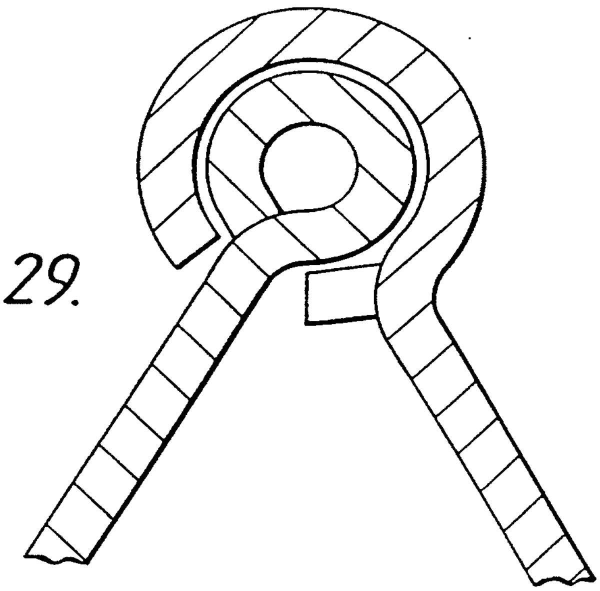


Fig.28.



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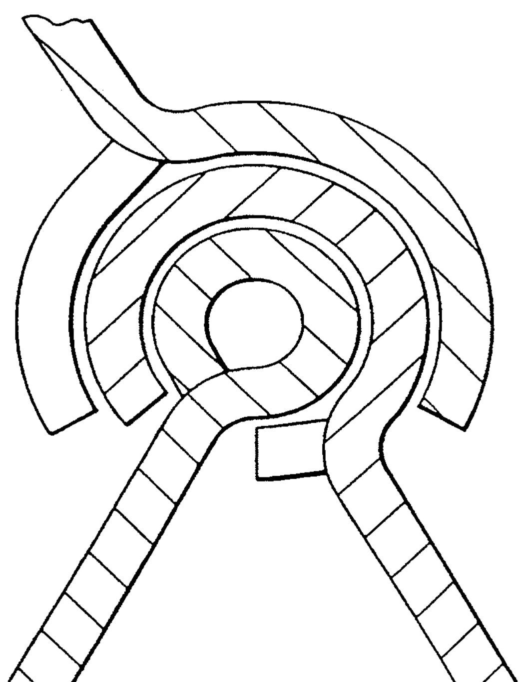

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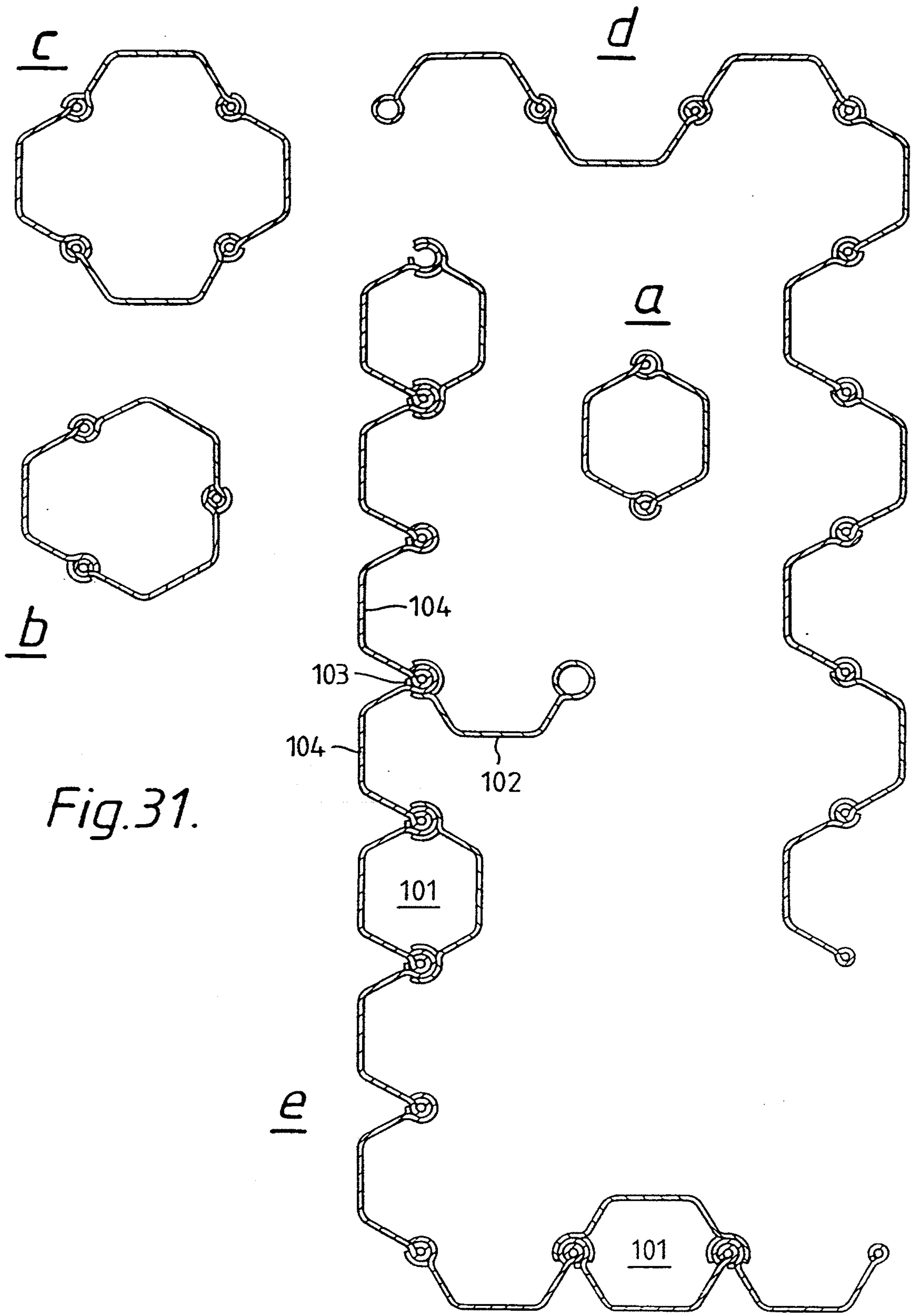

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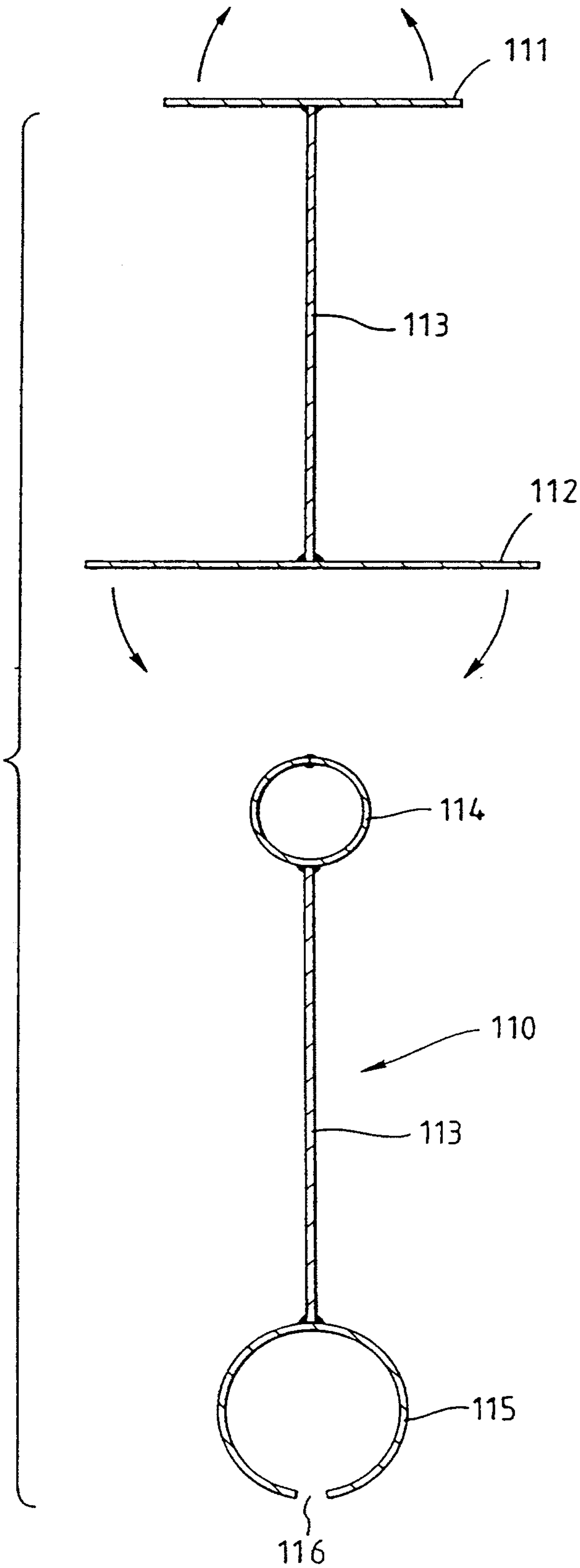


Fig.32.

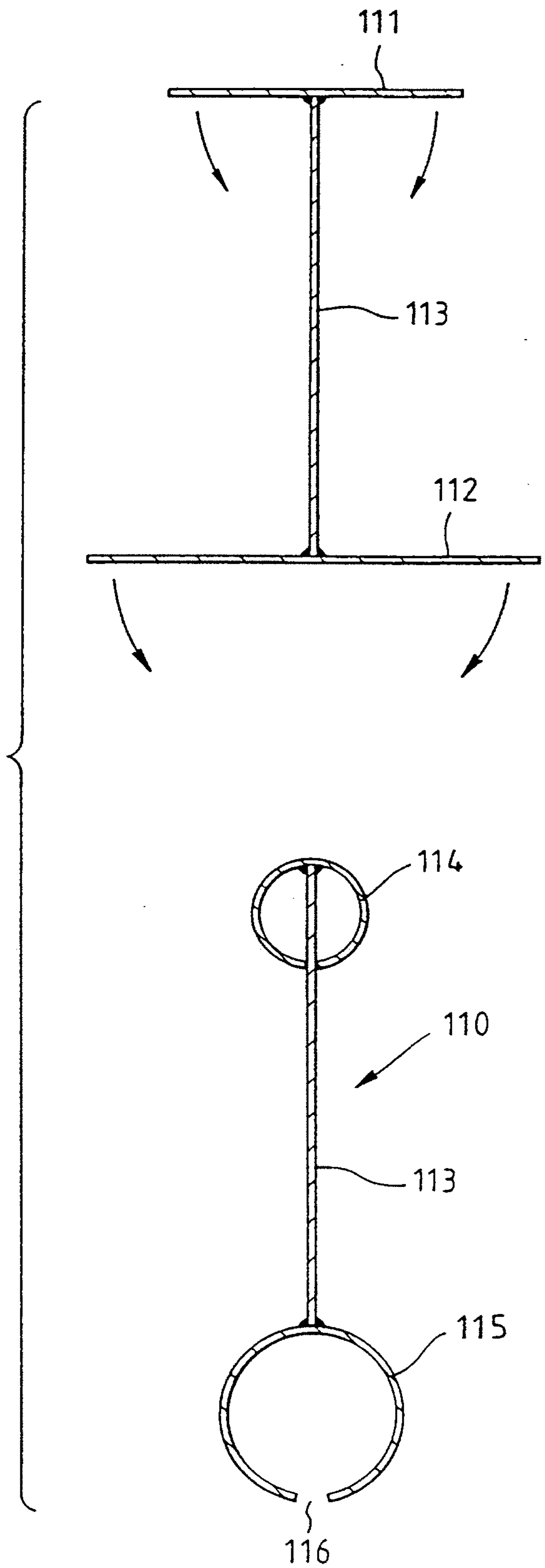
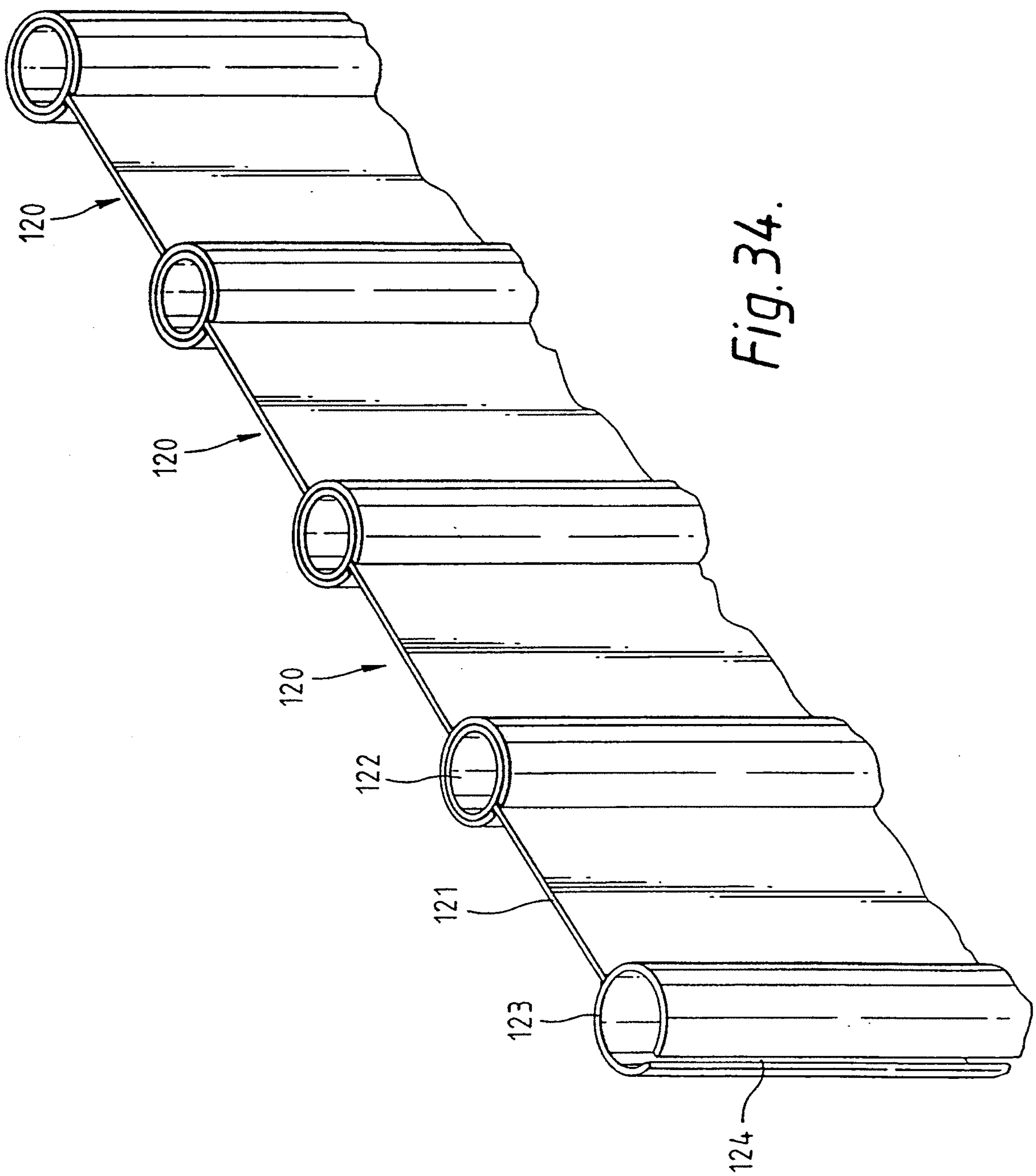


Fig. 33.



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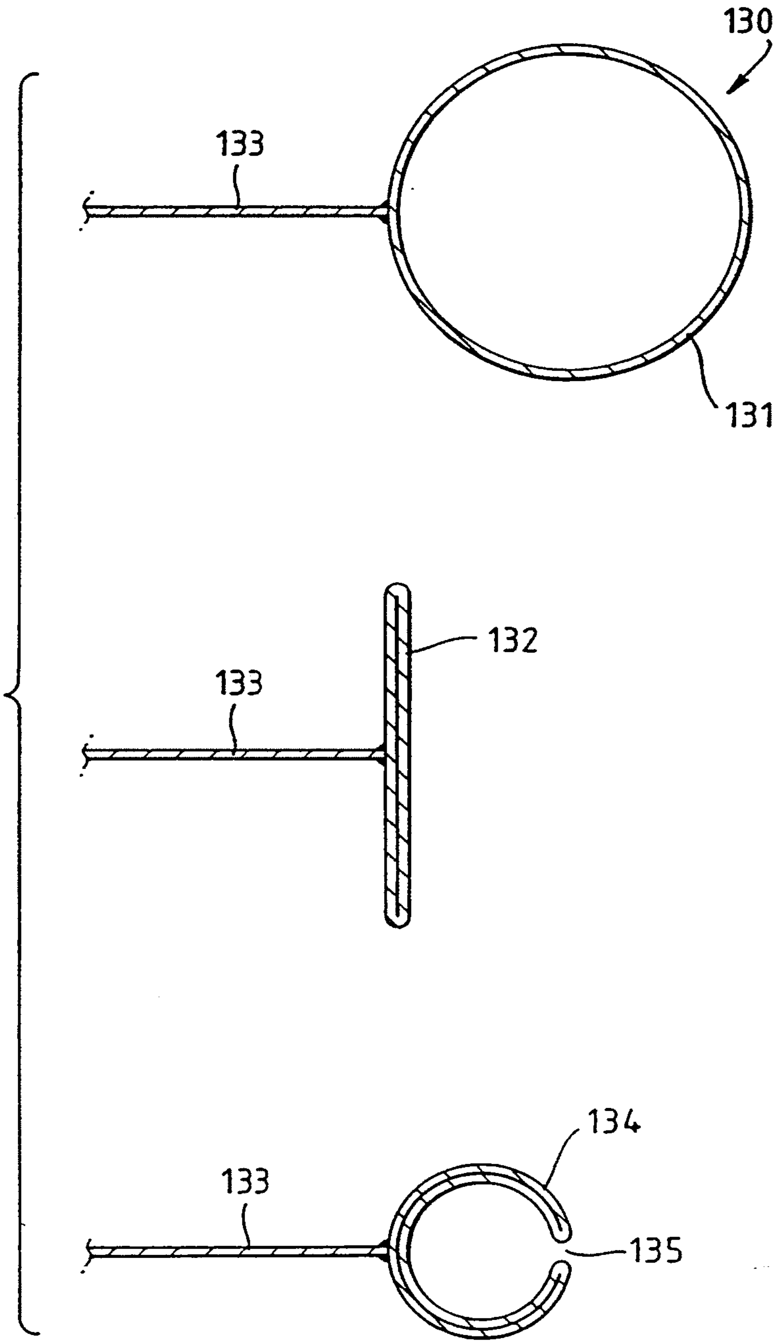

Fig. 35.